RTCA Special Committee 186, Working Group 3

ADS-B 1090 MOPS, Revision A

Meeting #3

ACTION ITEM 2-14

Enhanced Surveillance Processing Test Procedures

Initial Draft

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SUMMARY

A principal focus of Rev A to the 1090 MOPS is the addition of test procedures for the enhanced surveillance processing techniques. An approach to these test procedures has been discussed at the Washington and Melbourne meetings.

This Working Paper contains an initial draft of proposed enhanced surveillance processing test procedures based on the test concept discussed at the previous meetings of WG-3.

1.0   Introduction

A principal focus of Rev A to the 1090 MOPS is the addition of test procedures for the enhanced surveillance processing techniques. An approach to these test procedures has been discussed at the Washington and Melbourne meetings.

This Working Paper contains an initial draft of proposed enhanced surveillance processing test procedures based on the test concept discussed at the previous meetings of WG-3.

2.0   Initial Draft Test Procedures

The initial draft of the enhanced surveillance processing test procedures is enclosed in this Working Paper. The structure of these test procedures identifies the following test categories:

Preamble Detection Tests

Probability of preamble detection with overlapping ATCRBS Fruit

False alarms due to ATCRBS Fruit

Data Block Tests

Probability of correct reception with overlapping ATCRBS Fruit

Probability of correct reception with overlapping Mode S Fruit

The initial draft only contains material on the data block tests with ATCRBS fruit.

2.4.N   Enhanced Surveillance Test Procedures

2.4.N.1General

Note: This section defines the tests that are conducted to evaluate the performance of the improved preamble and enhanced squitter reception techniques of the equipment under test.

The tests shall consist of injecting a known Mode S extended squitter waveform at a nominal power level with a defined fruit overlap scenario. The performance of preamble detection and data block reception shall be measure separately.

The success criteria for the tests require the monitoring of the Mode S extended squitter data content. This data shall be available for test monitoring. Report level monitoring is not adequate.

In the following tests, the parameter "**T**" defines the number of trial that shall be executed. Unless otherwise indicated, "**T**" shall equal 1000.

2.4.N.2Signal Sources

2.4.N.2.1   ATCRBS Fruit Signal Source

Five RF sources shall be provided that are capable of generating ATCRBS 14-pulse replies. Each fruit source shall be capable of the following:

The waveform shall consist of bracket pulses and five data pulses. The data content of the fruit reply shall be randomly varied each time a fruit reply is generated. The 5 data pulses shall be uniformly randomly distributed across the 12 data bit positions (the **X** pulse position shall not be used).

Each fruit source shall be able to generate an ATCRBS reply at a received power level of **_TBD_** dBm. The fruit sources shall operate at the same power level, plus or minus 1 dB.

The fruit sources shall be able to sustain a repetition rate of at least 1000 replies per second.

The signals for each of the fruit sources shall be non-coherent with any of the other fruit sources and the desired extended squitter signal source.

The leading edge of the P1 pulse of a Mode S waveform shall be defined as t=0. The timing of the generation of the beginning of the F1 pulse of each fruit reply shall be controllable to be uniformly randomly distributed over one of the following intervals (depending on the test):

-20 to + 8 microseconds (Extended squitter preamble with ATCRBS fruit test)

+ 8 to + 120 microseconds (Extended squitter data with ATCRBS fruit test)

The random timing of the generation of fruit replies from each fruit source shall be independent of the timing of the other fruit sources.

2.4.N.2.2   Mode S Fruit Signal Source

One RF source shall be provided that is capable of generating a Mode S 112-bit squitter transmission as follows:

The signal source shall be able to accept an arbitrary 112-bit format for insertion into the squitter signals.

The Mode S fruit source shall be able to sustain a squitter rate of at least 1000 squitters per second.

The Mode S fruit power level shall the same as that used for the ATCRBS fruit, plus or minus 1 dB with no more than 1 dB droop.

The signal for the Mode S fruit source shall be non-coherent with the desired extended squitter signal source.

The leading edge of the P1 pulse of a Mode S waveform shall be defined as t=0. The timing of the generation of the beginning of the P1 pulse of the Mode S fruit waveform shall be controllable to be uniformly randomly distributed over one of the following intervals (depending on the test):

-120 to +8 microseconds (Extended squitter preamble with Mode S fruit test)

+8 to +120 microseconds (Extended squitter data with Mode S fruit test)

2.4.N.2.3   Extended Squitter Signal Source

One RF source shall be provided that is capable of generating a 112-bit extended squitter transmission with no more than 1 dB droop as follows:

The extended squitter power level shall be adjustable relative to the fruit power level over the following steps (in dB):   -20, -10, -5, 0, +5, +10, +20.

The extended squitter signal source shall be able to sustain a squitter rate of at least 1000 squitters per second.

The contents of the extended squitter transmission shall consist of the five-bit DF field set to 17, an 83-bit field that is set randomly for each extended squitter transmission, and a 24-bit PI field appropriate for the content of this transmission.

Provision shall be made to record the contents of each extended squitter transmission

Note: This information is required to check for undetected errors.

2.4.N.3   Preamble Detection Tests

2.4.N.3.1   Preamble Detection Tests with ATCRBS Fruit

2.4.N.3.1.1   General

TBD

2.4.N.3.2   Preamble False Alarm Tests with ATCRBS Fruit

2.4.N.3.2.1   General

TBD

2.4.N.4   Data Block Tests

2.4.N.4.1   Data Block Tests with ATCRBS Fruit

2.4.N.4.1.1   General

The following tests shall measure the performance of the equipment under test in decoding the extended squitter data content. The test series shall begin with monitoring the reception performance in the absence of interference to establish that the equipment under test is operating correctly.

Next, tests shall be conducted with an increasing number of fruit overlaps in the range of one to five. For each test, the timing of the overlapping fruit shall be uniformly randomly distributed across the data block for seven different relative power levels. For any given test, the power level of all fruit replies shall be the same (plus or minus 1 dB). **T** samples shall be taken at each power level. Squitters that are declared to be correctly received (i.e., received without errors or successfully error corrected), shall be compared to the known content of the extended squitter transmission. Any difference between the content of the decoded squitter and the known content of the injected squitter shall recorded as an undetected error and that squitter reception shall be removed from the count of successfully received squitters.

The observed probability of correct squitter reception for each relative power level shall be computed. An average value of the performance across all power levels shall be

computed and compared to the required performance to determine success or failure for the test.

2.4.N.4.1.2   Step 0: Verification of Operation of Equipment Under Test

Connect the extended squitter signal source and verify that the signal is received at a power level corresponding to the 0 dB relative ATCRBS fruit level. Inject the signal **T** times and record the extended squitters that are declared to be output as error free. Compare the decoded content of each extended squitter with the known content of the injected extended squitter. Any differences that are detected shall be recorded as an undetected error and that squitter reception shall be deleted from the count of error free receptions.

Calculate the measured probability of correct receptions and the number of undetected errors. The test is passed if the probability of correct receptions is at least 95% and there is no more than one undetected error event.

If this test is successful, proceed to Step 1. Otherwise, the test setup and equipment under test shall be checked and Step 0 shall be repeated.

2.4.N.4.1.3   Step 1: Test with One ATCRBS Fruit Overlap

Set the Mode S signal source as specified in Step 0.

Activate one ATCRBS fruit source so that the fruit is randomly distributed across the data Mode S data block as specified in 2.4.N.2.1.

Set the extended squitter power to -20 dB relative to the ATCRBS fruit signal level.

Inject the extended squitter waveform **T** times and record the receptions that are declared to be error free. Check for undetected errors and adjust as necessary the number of correctly received replies as specified in 2.4.N.4.1.2. Calculate the measured probability of correct reception and the number of undetected errors.

Repeat the above step for relative powers of -10, -5, 0, +5, +10, and + 20 dB.

Calculate the average probability of reception and the total number of undetected errors across the seven power levels.

2.4.N.4.1.4   Step 2: Test with Two ATCRBS Fruit Overlaps

Repeat Step 1 with two fruit overlaps and record the results.

2.4.N.4.1.5   Step 3: Test with Three ATCRBS Fruit Overlaps

Repeat Step 1 with three fruit overlaps and record the results.

2.4.N.4.1.6   Step 4: Test with Four ATCRBS Fruit Overlaps

Repeat Step 1 with four fruit overlaps and record the results.

2.4.N.4.1.7   Step 5: Test with Five ATCRBS Fruit Overlaps

Repeat Step 1 with five fruit overlaps and record the results.

2.4.N.4.1.8   Step 6: Determination of Success or Failure

Compare the results recoded above with the requirements in Table 2.4.N-1.

Table 2.4.N-1: Success Criteria for Data Block Tests

Number of Fruit	1	2	3	4	5
Minimum Probability					
Max Undetected Errors					

2.4.N.4.2   Data Block Tests with Mode S Fruit

2.4.N.4.2.1   General

TBD